Training Dose

Throughout the rehabilitation process of stroke patients, a central question arises about the best way to optimize the training of impaired upper limb functions. Parallel to the issue of the training type, the question of the necessary dose of training, varying from one patient to another and to which a patient will have to submit, is of considerable importance in that it directly influences the rehabilitation process.

The course of a rehabilitation process is usually divided into 3 distinct phases, namely the acute, subacute and chronic phases.

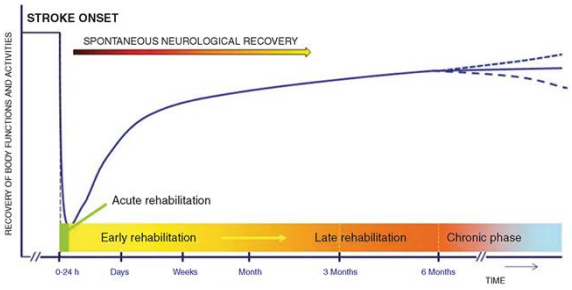
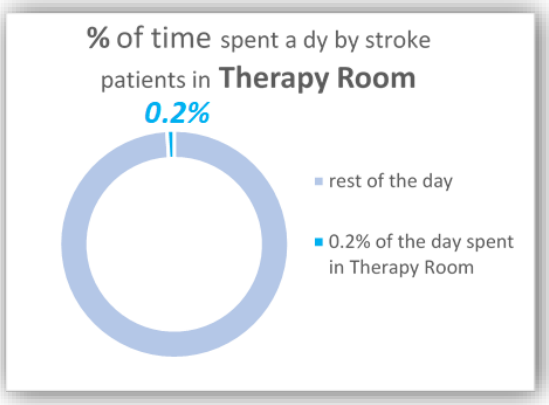


Figure 1 : *Langhorne, P., Bernhardt, J., & Kwakkel, G. (2011). Stroke rehabilitation. The Lancet, 377(9778), 1693-1702.*

The acute phase, spread out over the first few days following the stroke episode, corresponds to the phase during which patients responding to therapy show the greatest part of recovery, especially through the process of spontaneous neurological recovery. Then the recovery process slows down during the so named sub-acute phase although still continuing to increase. After around 6 months the patient enters the chronic phase of recovery during which the «acquired non-use» effect can be observed. This process consists, as its name suggests, in the regression of the functions acquired via training during recovery because of their daily non-use. Therefore, one of the main objectives of therapists is to counter this effect by maintaining an optimal training level of the body functions in question.

Considering therapies generally applied to stroke patients, one important problem apparently lies in the fact that the training dose in stroke rehabilitation is currently rather low and overestimated [Lang and al., 2009]. Indeed, [Bernhardt and al., 2004] described that within 14 days following stroke, only 13% of the stroke patient's day is used to perform ''tasks'' relevant for their rehabilitation process, which is very little. Furthermore, according to the same authors, patients spend 0.2% of their daily time in therapy room, which logically limits the time spent in therapy.



Desweitern hat sich herausgestellt, dass lediglich 0.2 % des Tages in einem Therapieraum verbracht werden und der Patient somit eine Aufforderung zum aktiven Training erhält.

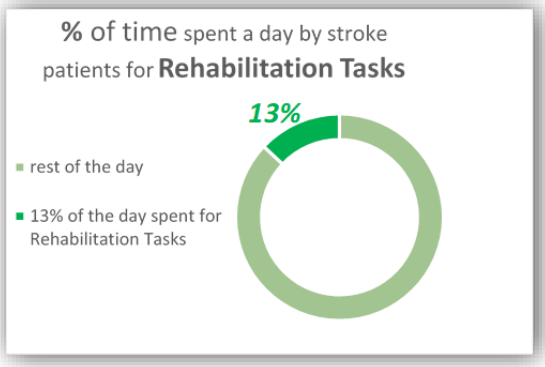


Figure 2 & 3: *Bernhardt, J., Dewey, H., Thrift, A., & Donnan, G. (2004). Inactive and alone. Stroke, 35(4), 1005-1009.*

During several years, it was generally adopted by neuroscientists, that the more the patient trains, and this as soon as possible, the better the recovery, or in other words, higher dose is better [Hayward and al., 2015]. This statement was sustained by several studies and meta-analyzes and led to consider this approach as the best way to apply training to stroke patients, although the figures evoked in the study of [Bernhardt and al., 2004] clearly show off the difference between the theoretical and applied aspects.

However, this consideration was challenged over the last years by new publications, like the one of [Winstein and al., 2016] which led to the conclusion that dose finally does not matter as much as we used to think, or via the study of the [AVERT Trial Collaboration group, 2015] which emphasized that too much training too early could even exert a detrimental effect on the recovery process. One year later, the same research group deepened its study by trying to identify and distinguish parameters which leaded to this last conclusion. Their work allowed

to gain a better insight in the Dose-Response relationship of the stroke rehabilitation process, and more precisely to give information about how early, how long and how frequent training sessions should be performed, parameters which were previously rarely considerated [AVERT Trial Collaboration group, 2016]. Thus, they showed that both too long mobilization and too early mobilization lower the probability for a favorable outcome whereas increasing the frequency of mobilization increases the odds for a better outcome.

Finally, all these results suggest that the best way of applying recovery should be considering an approach promoting more frequent sessions but also sessions of shorter durations.

Based on all these studies, it is therefore understandable that the problem of the training dose in the process of stroke rehabilitation tends to be more complex than simply imposing the most possible training to patients. Because the characteristics of each person are different, the amount of exercise must be adapted to the personal needs in order to maximize the chances of recovery of each individual.

By considering all phases of recovery in a more general way, it is essential to use the whole restoration potential of each patient and this, as fast as possible. So, it becomes necessary to be in possession of a means allowing to quickly quantify patient's needs and to adapt rehabilitation to them. Here again intervenes the importance of the optimization of the training dose in the process of recovery.

Most of the time, therapies target the subacute phase of recovery, some practical aspects limiting the possibility of influencing the acute phase although it is targeted too. But as mentioned before, it is also of great importance to provide tools enabling the patients to avoid the degradation of the functions acquired during their training, which is an inherent effect in the entry into the chronic phase of the recovery process.

One possibility to counter this non-use is logically to provide daily training exercises to patients. However, even with an adapted training plan, the repetition of exercises over weeks and months can greatly undermine the patient's motivation and therefore interfere with its recovery process.

Thus, it would be more effective to develop of a system able to adapt over time the requirements of the requested exercises while maintaining intact the patient's motivation several months after the start of their therapy. To do this, this system must be able to quantify the effective dose of training performed by patients in order to adapt it, but also to influence the frequency of training via its capacity to stimulate the motivation of the users, and to enable an independent daily work.

All these needs are covered by the ARYS™ system provided by yband therapy AG which additionally offers the user a fun interface necessary to keep motivation high over time.